

# CONSTRUCTION TRADES

(CIP: 46.0000)

Including Heating, Ventilation & AC 47.0201

## SCORING RUBRIC

The student demonstrates the specified level of competency in occupational skills:

0	1	2	3	4
No Exposure	Introduced	Practiced	Entry-Level	Competency

## BASIC CONSTRUCTION SKILLS

0 1 2 3 4

00000	A.	Orientation to the Trade
00000	B.	Safety
00000	C.	Math
00000	D.	Hand Tools
00000	E.	Power Tools
00000	F.	Blueprints
00000	G.	Wood Materials and Fastening

Specialization Options  
(choose at least 2 sub areas)

## CARPENTRY – LEVEL I

00000	A.	Rigging
00000	B.	Tools
00000	C.	Floor Systems
00000	D.	Wall and Ceiling Framing
00000	E.	Roof Framing
00000	F.	Windows and Exterior Doors

## CARPENTRY – LEVEL II

00000	A.	Reading Plans and Elevations
00000	B.	Site Layout I: Distance Measurement and Leveling
00000	C.	Introduction to Concrete and Reinforcing Materials
00000	D.	Foundations and Flatwork
00000	E.	Concrete Forms
00000	F.	Reinforcing Concrete
00000	G.	Handling and Placing Concrete
00000	H.	Patented Forms
00000	I.	Tilt-Up Wall Systems

## MASONRY

- 00000 A. Residential Plans and Drawing Interpretation
- 00000 B. Residential Masonry
- 00000 C. Grout and Other Reinforcement
- 00000 D. Metal Work in Masonry
- 00000 E. Advanced Laying Techniques
- 00000 F. Construction Techniques and Moisture Control
- 00000 G. Elevated Work
- 00000 H. Construction Inspection and Quality Control

## CONCRETE FINISHING

- 00000 A. Introduction to Concrete Construction and Finishing
- 00000 B. Safety Requirements
- 00000 C. Properties of Concrete
- 00000 D. Tools and Equipment
- 00000 E. Preparing and Placement
- 00000 F. Placing Concrete
- 00000 G. Finishing: Part I
- 00000 H. Curing and Protecting Concrete
- 00000 I. Introduction to Troubleshooting

## PLUMBING

- 00000 A. The Plumbing Trade
- 00000 B. Basic Plumbing Tools
- 00000 C. Math for Plumbers
- 00000 D. Introduction to Plumbing Blueprint Reading
- 00000 E. Reading Residential Plumbing Drawings
- 00000 F. Joining Plastic Pipe and Fittings
- 00000 G. Soldering and Brazing Copper Tubing and Fittings
- 00000 H. Cutting and Threading Carbon Steel Pipe
- 00000 I. Joining Cast-Iron Pipe and Fittings
- 00000 J. Making Flared and Compression Joints with Copper Tube
- 00000 K. Installing Traps and Interceptors
- 00000 L. Fitting and Cleanout Requirements for DWV Piping
- 00000 M. Installing Natural Gas Piping
- 00000 N. Installing LPG Piping Systems
- 00000 O. Installing Fuel Oil Piping Systems

## ELECTRICAL

00000	A.	Electrical Safety
00000	B.	Hand Bending
00000	C.	Anchors and Supports
00000	D.	Electrical Theory One
00000	E.	Electrical Theory Two
00000	F.	Electrical Test Equipment
00000	G.	Introduction to the National Electrical Code
00000	H.	Raceways, Boxes, and Fittings
00000	I.	Conductors
00000	J.	Introduction to Electrical Blueprints
00000	K.	Electrical Wiring: Commercial and Industrial
00000	L.	Electrical Wiring: Residential

## HAVC

00000	A.	Trade Mathematics
00000	B.	Tools of the Trade
00000	C.	Copper and Plastic Piping Practices
00000	D.	Soldering and Brazing
00000	E.	Ferrous Metal Piping Practices
00000	F.	Basic Electricity
00000	G.	Introduction to Cooling
00000	H.	Introduction to Heating

## INDUSTRIAL MAINTENANCE – LEVEL I

00000	A.	Electrical Safety
00000	B.	Hand Bending
00000	C.	Fasteners and Anchors
00000	D.	Electrical Theory One
00000	E.	Electrical Theory Two
00000	F.	Electrical Test Equipment
00000	G.	Introduction to the National Electrical Code
00000	H.	Conductors
00000	I.	Introduction to Electrical Blueprints
00000	J.	Oxyfuel Cutting

## INDUSTRIAL MAINTENANCE – LEVEL II

00000	A.	Wiring: Commercial & Industrial
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- 00000      **B.      Alternating Current**
- 00000      **C.      Motors: Theory and Application**

## Directions

Evaluate the student by checking the appropriate box to indicate the degree of Competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

### Rating Scale:

- 0 No Exposure**
- 1 Introduced** – the student has been exposed through non-participatory instruction (e.g. lecture, demonstration, field trip, and video).
- 2 Practiced** – the student can perform the task with direct supervision.
- 3 Entry-Level Competency** – the student can perform the task with limited supervision and/or does not perform the task to standard (a typical entry-level performance expectation).
- 4 Competency** – the student consistently performs task to standard with no supervision (on at least two occasions or at instructor's option).

## Building Trades Core Instruction

### BASIC CONSTRUCTION SKILLS

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#### A. Orientation to the Trade

- A.001 Describe the history of the carpentry trade.
- A.002 Identify the stages of progress within the carpentry trade.
- A.003 Identify the responsibilities of a person working in the construction industry.
- A.004 State the personal characteristics of a professional.
- A.005 Explain the importance of safety in the construction industry.

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#### B. Safety

- B.001 Describe how to avoid job-site accidents.
- B.002 Explain the relationship between housekeeping and safety.
- B.003 Appreciate the importance of following all safety rules and company safety policies.
- B.004 Explain the importance of reporting all on-the-job injuries, accidents, and near misses.
- B.005 Explain the need for evacuation procedures and the importance of following them.
- B.006 Explain their employer's substance abuse policy and how it relates to their safety.
- B.007 Use proper safety practices when welding or working around welding operations.
- B.008 Use proper safety practices when working in or near trenches and excavations.
- B.009 Explain the term Proximity Work.
- B.010 Follow safe practices when working near pressurized or high-temperature systems.
- B.011 Know and follow the safety requirements for working in confined spaces.
- B.012 Explain and practice safe lockout-tagout procedures.
- B.013 Know the different types of barriers and barricades, and where they should be used.
- B.014 Recognize and explain personal protective equipment uses.
- B.015 Inspect and care for various types of personal protective equipment.
- B.016 Follow safe procedures for lifting heavy objects.
- B.017 Inspect and safely work with various types of ladders and scaffolds.
- B.018 Demonstrate an understanding of the OSHA Hazard Communication Standard.
- B.019 Explain the function of Material Safety Data Sheets.
- B.020 Explain the process by which fires start.
- B.021 Practice fire prevention in dealing with various flammable materials.
- B.022 Explain the classes of fires, and the type(s) of extinguishers to use for each.
- B.023 Explain why injuries result when electrical contact occurs.
- B.024 Practice safe work procedures around electrical hazards.
- B.025 Take action if present when an electrical shock occurs.



**C.**

**Math**

- C.001 Add, subtract, multiply, and divide whole numbers, with and without a calculator.
- C.002 Use a standards and metric ruler to measure.
- C.003 Add, subtract, multiply, and divide fractions.
- C.004 Add, subtract, multiply, and divide decimals, with and without a calculator.
- C.005 Convert decimals to percents and percents to decimals.
- C.006 Convert fractions to decimals and decimals to fractions.
- C.007 Explain what the Metric System is and its importance in the construction trade.
- C.008 Recognize and use metric units of length, weight, volume, and temperature.



**D.**

**Hand Tools**

- D.001 Recognize basic hand tools used in the construction trade.
- D.002 Safely use these basic hand tools.
- D.003 Have an awareness of basic maintenance procedures on these hand tools.



**E.**

**Power Tools**

- E.001 Identify commonly used power tools of the construction trade.
- E.002 Recognize safe use of power tools.
- E.003 Explain the procedures to properly maintain these power tools.



**F.**

**Blueprints**

- F.001 Identify and recognize basic blueprint terms and symbols.
- F.002 Relate information on prints to real parts and locations.



**G.**

**Wood Materials and Fastening**

- G.001 Explain the terms commonly used in discussing wood and lumber.
- G.002 State the uses of various types of hardwoods and softwoods.
- G.003 Identify various types of imperfections that are found in lumber.
- G.004 Explain how lumber is graded.
- G.005 Interpret grade markings on lumber and plywood.
- G.006 Explain how plywood is manufactured, graded, and used.
- G.007 Identify various types of building boards and identify their uses.
- G.008 Identify the uses of and safety precautions associated with pressure-treated lumber.
- G.009 Describe the proper method of caring for limber and wood building materials at the job site.
- G.010 State the uses of various types of engineered lumber.
- G.011 Calculate the quantities of lumber and wood products using industry-standards methods.
- G.012 List the basic nail and staple types and their uses.
- G.013 List the basic types of screws and their uses.
- G.014 Identify the different types of anchors and their uses.
- G.015 Describe the common types of adhesives used in construction work and explain their uses.

**Specialized Options**  
(Choose at least 2 sub areas – e.g., A, B, C...)

**CARPENTRY – LEVEL I**



**A.**

**Rigging**

- A.001 Explain and practice rigging safety.
- A.002 Identify and explain rigging equipment.
- A.003 Inspect rigging equipment.
- A.004 Identify, explain, and perform crane hand signals.
- A.005 Estimate size, weight, and center of gravity.
- A.006 Tie knots.
- A.007 Identify and explain types of derricks.
- A.008 Identify and explain types of cranes.
- A.009 Rig and move materials and equipment.



## **B. Tools**

- B.001 Identify the hand tools commonly used by carpenters and describe their uses.
- B.002 Use hand tools in a safe and appropriate manner.
- B.003 State the general safety rules for operating all power tools, regardless of type.
- B.004 State the general rules for properly maintaining all power tools, regardless of type.
- B.005 Identify the portable power tools commonly used by carpenters and describe their uses.
- B.006 Use portable power tools in a safe and appropriate manner.
- B.007 Identify the stationary power tools commonly used by carpenters and describe their uses.
- B.008 Use stationary power tools in a safe and appropriate manner.



## **C. Floor Systems**

- C.001 Identify the different types of framing systems.
- C.002 Read and understand drawings and specifications to determine floor system requirements.
- C.003 Identify floor and sill framing and support members.
- C.004 Name the methods used to fasten sills to the foundation.
- C.005 Given specific floor load and span data, select the proper girder/beam size from a list of available girders/beams.
- C.006 List and recognize different types of floor joists.
- C.007 Given specific floor load and span data, select the proper joist size from a list of available joists.
- C.008 List and recognize different types of bridging.
- C.009 List and recognize different types of flooring materials.
- C.010 Explain the purposes of subflooring and underlayment.
- C.011 Match selected fasteners uses in floor framing to their correct uses.
- C.012 Estimate the amount of material needed to frame a floor assembly.
- C.013 Demonstrate the ability to:
  - Lay out and construct a floor assembly
  - Install bridging
  - Install joists for a cantilever floor
  - Install a subfloor using butt-joint plywood/OSB panels
  - Install a single floor system using tongue-and-groove plywood/OSB panels.



## **D. Wall and Ceiling Framing**

- D.001 Identify the components of a wall and ceiling layout.
- D.002 Describe the procedure for laying out a wood frame wall, including plates, corner posts, door and window openings, partition T's, bracing, and firestops.
- D.003 Describe the correct procedure for assembling and erecting an exterior wall.
- D.004 Describe the common materials and methods used for installing sheathing on walls.
- D.005 Lay out, assemble, erect, and brace exterior walls for a frame building.
- D.006 Describe wall-framing techniques used in masonry construction.
- D.007 Explain the use of metal studs in wall framing.
- D.008 Describe the correct procedure for laying out a ceiling.
- D.009 Cut and install ceiling joists on a wood frame building.
- D.010 Estimate the materials required to frame walls and ceilings.



## **E. Roof Framing**

- E.001 Understand the terms associated with roof framing.
- E.002 Identify the roof-framing members used in gable and hip roofs.
- E.003 Identify the methods used to calculate the length of a rafter.
- E.004 Identify the various types of trusses used in roof framing.
- E.005 Use a rafter framing square, speed square, and calculator in laying out a roof.
- E.006 Identify various types of sheathing used in roof construction.
- E.007 Frame a gable roof with vent openings.
- E.008 Frame a roof opening.
- E.009 Construct a frame roof, including hips, valleys, commons, jack rafters, and sheathing.
- E.010 Erect a gable roof using trusses.
- E.011 Estimate the materials used in framing and sheathing a roof.



**F.**

**Windows and Exterior Doors**

- F.001 Identify various types of fixed, sliding, and swinging windows.
- F.002 Identify the parts of a window installation.
- F.003 State the requirements for a proper window installation.
- F.004 Install a pre-hung window.
- F.005 Identify the common types of skylights and roof windows.
- F.006 Describe the procedure for properly installing a skylight.
- F.007 Identify the common types of exterior doors and explain how they are constructed.
- F.008 Identify the parts of a door installation.
- F.009 Identify the types of thresholds used with exterior doors.
- F.010 Install a threshold on a concrete floor.
- F.011 Install a pre-hung exterior door with weather-stripping.
- F.012 Identify the various types of locksets used on exterior doors and explain how they are installed.
- F.013 Explain the correct installation procedure for a rollup garage door.
- F.014 Install a lockset.

**CARPENTRY - LEVEL II**



**A.**

**Reading Plans and Elevations**

- A.001 Describe the types of drawings usually included in a set of plans and list the information found on each type.
- A.002 Identify the different types of lines used on construction drawings.
- A.003 Identify selected architectural symbols commonly used to represent materials on plans.
- A.004 Identify selected electrical, mechanical, and plumbing symbols commonly used on plans.
- A.005 Identify selected abbreviations commonly used on plans.
- A.006 Read plans, elevations, schedules, etc., contained in basic construction drawings.
- A.007 State the purpose of written specifications.
- A.008 Understand and identify the parts of a specification.
- A.009 Demonstrate or describe how to perform a quantity takeoff for materials.



**B.**

**Site Layout I: Distance Measurement and Leveling**

- B.001 Describe the major responsibilities of the carpenter relative to site layout.
- B.002 Interpret site/plot drawings.
- B.003 Convert measurements stated in feet and inches to equivalent measurements stated in decimal feet and vice versa.
- B.004 Recognize, use, and properly maintain tools and equipment associated with taping.
- B.005 Use taping equipment and procedures to make distance measurements and perform site layout tasks.
- B.006 Determine approximate distances by pacing.
- B.007 Recognize, use, and properly care for tools and equipment associated with differential leveling.
- B.008 Use a builder's level or transit and differential leveling procedures to determine site and building elevations.
- B.009 Record site layout data and information in field notes using accepted practices.
- B.010 Check and/or establish 90° angles using the 3/4/5 rule.



**C.**

**Introduction to Concrete and Reinforcing Materials**

- C.001 Identify various types of cement and describe their uses.
- C.002 Identify types and sizes of concrete aggregates.
- C.003 Identify types of concrete admixtures and describe their uses.
- C.004 Identify special types of concrete and describe their uses.
- C.005 Identify concrete curing methods and materials.
- C.006 Identify concrete testing methods.
- C.007 Demonstrate sampling methods used for the testing of concrete.
- C.008 Perform slump testing of concrete.
- C.009 Perform casting of specimens for strength testing of concrete.
- C.010 Perform volume estimates for concrete quantity requirements.
- C.011 Identify types of concrete reinforcement bars and describe their uses.



- C.012 Identify types of reinforcement bar supports and describe their uses.  
 C.013 Identify types of welded-wire fabric reinforcement material and describe their uses.



**D.**

### **Foundations and Flatwork**

- D.001 Recognize four kinds of footings:
- Continuous or spread
  - Stepped
  - Pier
  - Grade beam
- D.002 Identify the parts of footing forms and explain their purpose.
- D.003 Identify the parts of pier forms and explain their purpose.
- D.004 Demonstrate the ability to lay out and construct selected footing forms, including:
- Continuous footing
  - Pier footing
  - Pile cap
  - Grade beam
- D.005 Strip a pier footing form and prepare it for erection at another location.
- D.006 Recognize types of concrete pours that require the construction of edge forms:
- Slabs with or without a foundation
  - Parking lots
  - Driveways and streets
  - Sidewalks
  - Approaches
- D.007 Identify the parts of edge forms and explain their purpose.
- D.008 Demonstrate the ability to construct and disassemble edge forms for:
- A slab-on-grade with an existing foundation
  - A slab-on-grade with an integral foundation
- D.009 Explain the purpose of a screed and identify the different types of screeds.
- D.010 Demonstrate the ability to set screeds on grade.

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**E.**

### **Concrete Forms**

- E.001 Identify the various types of concrete forms.
- E.002 Identify the components of each type of form.
- E.003 Explain the safety procedures associated with using concrete forms.
- E.004 Construct wall, column, beam, and stair forms.

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**F.**

### **Reinforcing Concrete**

- F.001 Describe the applications of reinforcing bars, the uses of reinforced structural concrete, and the basic processes involved in placing reinforcing bars.
- F.002 Recognize and identify the bar bends standardized by the American Concrete Institute.
- F.003 Read and interpret bar lists and describe the information found on a bar list.

- F.004 List the types of ties used in securing reinforcing bars.
- F.005 State the tolerances allowed in the fabrication of reinforcing bars.
- F.006 Demonstrate the use of common ties for reinforcing bars.
- F.007 Describe methods by which reinforcing bars may be cut and bent in the field.
- F.008 Identify the tools and equipment needed for installing reinforcing bars.
- F.009 Demonstrate the ability to safely use selected tools and equipment to cut, bend, and install reinforcing materials.
- F.010 Explain the necessity of concrete cover in placing reinforcing bars.
- F.011 Explain and demonstrate how to place bars in walls, columns, beams, girders, joists, and slabs.
- F.012 Identify lapped and welded splices.

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**G.**

**Handling and Placing Concrete**

- G.001 Identify and state the purpose of different types of concrete joints.
- G.002 Recognize the various equipment used to transport and place concrete.
- G.003 Describe the factors that contribute to the quality of concrete placement.
- G.004 Demonstrate and/or describe the correct methods for placing and consolidating concrete into forms.
- G.005 Demonstrate and/or describe how to use a screed to strike off and level concrete to the proper grade in a form.
- G.006 Demonstrate and/or describe how to use a bullfloat and/or darby to level and smooth concrete.
- G.007 Determine what conditions permit the concrete finishing operation to start.
- G.008 Demonstrate and/or describe how to use a hand float and finishing trowel.
- G.009 Demonstrate and/or describe how to use an edger.
- G.010 Demonstrate and/or describe how to use a jointer.
- G.011 Name the factors that affect the curing of concrete and describe the methods used to achieve proper curing.
- G.012 Properly care for and safely use the hand and power tools used when working with concrete.

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**H.**

**Patented Forms**

- H.001 Recognize various types of patented forms.
- H.002 Identify the components of patented wall-forming systems.
- H.003 State the differences in construction and use for different types of forms.
- H.004 Describe how a flying form system is moved.
- H.005 Erect, plumb, and brace a patented wall form.
- H.006 Use a patented hardware system to erect forms of lumber and sheathing.
- H.007 Erect, plumb, and brace a patented column form.

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- I. Tilt-Up Wall Systems**
- I.001 Describe the history of tilt-up construction.
  - I.002 Explain the advantages and disadvantages of tilt-up construction.
  - I.003 Explain how aggregates are used to obtain the desired appearance in tilt-up wall panels.
  - I.004 Explain and/or demonstrate the correct method for preparing a floor slab to be used in forming tilt-up panels.
  - I.005 Explain and/or demonstrate the correct procedure for forming and finishing a tilt-up wall panel.
  - I.006 Explain and/or demonstrate the correct procedure for preparing Footings to receive tilt-up wall panels.
  - I.007 Explain and/or demonstrate the correct procedure for safely lifting and joining wall panels.
  - I.008 Select and properly place lifting and bracing inserts.

## II. Masonry

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- A. Residential Plans and Drawing Interpretation**
- A.001 Understand the organization of residential plans and drawings.
  - A.002 Interpret dimensions and scales on drawings.
  - A.003 Interpret information on residential plans.
  - A.004 Estimate materials quantities from plans and drawings.

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- B. Residential Masonry**
- B.001 Understand the requirements for construction of various types of residential foundations.
  - B.002 Identify and explain the characteristics, uses, and installation techniques for brick pavers.
  - B.003 Lay out and construct steps, patios, and decks made from masonry units.
  - B.004 Lay out and construct chimneys and fireplaces.

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- C. Grout and Other Reinforcement**
- C.001 Name and describe the primary ingredients in grout and their properties.
  - C.002 Identify the different types of grout used in masonry work.
  - C.003 Describe the common admixtures and their uses.
  - C.004 Describe the use of steel bar reinforcement in masonry construction.
  - C.005 Use the proper techniques to apply grout in low and high lifts.

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- D. Metal Work in Masonry**
- D.001 Describe the uses and installation of vertical reinforcement.
  - D.002 Describe the uses and installation of different types of horizontal joint reinforcements and ties.
  - D.003 Describe the uses and installation of different anchors, fasteners, and embedded items.
  - D.004 Describe the installation of hollow metal frames.

D.005 Describe the functions and installations of sills and lintels.

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**E. Advanced Laying Techniques**

E.001 Recognize the structural principles and fundamental uses of basic types of walls.

E.002 Recognize the requirement for, and function of, control joints and expansion joints.

E.003 Construct various types of walls using proper reinforcement, jointing, and bonding techniques.

E.004 Construct specialty structures such as manholes, segmented block walls, and screens.

E.005 Identify and explain the different types of masonry arches used today.

E.006 Construct a semicircular and jack arch.

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**F. Construction Techniques and Moisture Control**

F.001 Explain and demonstrate techniques for constructing masonry around windows, doors, and other openings.

F.002 Explain the requirements for wall bracing and demonstrate the techniques used to construct pilasters and other types of bracing.

F.003 Identify the various types of insulation used in conjunction with masonry construction and explain installation techniques.

F.004 Identify the need for moisture control in various types of masonry construction and demonstrate the techniques used to eliminate moisture problems.

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**G. Elevated Work**

G.001 Describe the appropriate steps necessary for setting up and maintaining elevated workstations.

G.002 Properly operate material handling and hoisting equipment.

G.003 Describe the safety requirements and guidelines employed in elevated and high-rise construction.

G.004 Describe basic activities that can be used on the job to prevent elevated workstation accidents.

G.005 Understand scaffolding positioning and how it affects laying technique.

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**H. Construction Inspection and Quality Control**

H.001 Discuss industry standards for quality control.

H.002 Build masonry sample panels and prisms.

H.003 Perform field tests on mortar.

H.004 Discuss and perform field inspections.

### III. CONCRETE FINISHING

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**A. Introduction to Concrete Construction and Finishing**

A.001 Define terms associated with concrete construction.

- A.002 Identify the composition and characteristics of concrete.
- A.003 Identify the uses of concrete as a building material.
- A.004 Identify the effect of craftsmanship on finished concrete.
- A.005 Explain the concrete construction process.
- A.006 Identify site operation work requirements.
- A.007 Explain the career potentials in concrete construction and finishing.

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**B.**

**Safety Requirements**

- B.001 Describe and wear different types of safety gear for the work site.
- B.002 State the guidelines for dressing appropriately for concrete work.
- B.003 Describe how to safely handle concrete when forming, placing, curing, and finishing.
- B.004 Describe safety precautions to follow when working in extreme heat and cold.
- B.005 Describe safety precautions to follow when working with hazardous materials.
- B.006 Describe proper procedures for handling and maintaining concrete construction tools safely.

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**C.**

**Properties of Concrete**

- C.001 Describe the properties of concrete.
- C.002 Explain how the properties of concrete are used in construction.
- C.003 Determine how the ingredients of concrete influence mix, placement, finishing, durability, and performance.
- C.004 Describe quality-control tests on concrete ingredients, fresh concrete, and hardened concrete.
- C.005 Mix a test batch of concrete.
- C.006 Perform a slump test.

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**D.**

**Tools and Equipment**

- D.001 Name the tools used in placing and finishing concrete.
- D.002 Name the power equipment used in placing and finishing concrete.
- D.003 Describe how each tool is used.
- D.004 Describe how the power equipment is used.
- D.005 Associate trade terms with the appropriate tools and equipment.

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**E.**

**Preparing and Placement**

- E.001 Describe basic site layout using levels and measuring tools.
- E.002 Properly locate, grade, and build forms for horizontal placement.
- E.003 Perform compaction activities on subgrades.
- E.004 Describe various joints and where to locate them.
- E.005 Describe various reinforcements and how to place them.
- E.006 Describe information needed when ordering concrete.

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**F.**

- F.001
- F.002
- F.003
- F.004
- F.005

**Placing Concrete**

- Describe how concrete is conveyed and placed.
- Draw up a pre-placement checklist.
- Demonstrate the use of equipment and tools for placing concrete.
- Demonstrate the process of depositing, spreading, consolidating, and striking off concrete in a form.
- Associate trade terms with the appropriate processes and equipment.

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**G.**

- G.001
- G.002
- G.003
- G.004
- G.005
- G.006

**Finishing: Part I**

- Describe the basic finishing process.
- Use the following finishing hand tools: float, edger, groover, and trowel.
- Mark and cut joints with a saw.
- Apply a broom finish.
- Apply a rubbing finish.
- Associate trade terms with the appropriate processes and equipment.

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**H.**

- H.001
- H.002
- H.003
- H.004
- H.005

**Curing and Protecting Concrete**

- Describe the process of curing concrete.
- Identify methods of curing concrete.
- Describe how each method is applied.
- Identify when each method is used.
- Associate trade terms with the appropriate processes and equipment.

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**I.**

- I.001
- I.002
- I.003

**Introduction to Troubleshooting**

- Describe a basic troubleshooting methodology that can be used to identify a variety of concrete construction problems and their causes.
- Identify problems with fresh concrete and describe ways to prevent them.
- Identify different concrete defects such as crazing, cracking, dusting, scaling, popouts, and efflorescence, and describe ways to prevent them.

**IV. PLUMBING**

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**A.**

- A.001
- A.002
- A.003

**The Plumbing Trade**

- Discuss the historical development of the trade.
- Discuss the functions of water supply and sewage treatment systems.
- Discuss the importance of plumbers in modern society.

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**B.**

- B.001
- B.002

**Basic Plumbing Tools**

- Discuss safety as it applies to plumbing tools.
- Identify the basic hand and power tools used in the plumbing trade.

B.003 Discuss the proper maintenance procedures to be used for hand and power tools.

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C.

### Math for Plumbers

C.001

Measure pipe using the following methods:

- End-to-end
- End-to-center
- Center-to-center
- End-to-face
- Face-to-face
- Face-to-crotch

C.002

Determine end-to-end dimensions by figuring fitting allowances and make-up.

C.003

Use a framing square to find the center of things.

C.004

Figure 45-degree offsets using the constant method.

C.005

Figure 45-degree offsets using a framing square and a wooden rule or tape measure.

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D.

### Introduction to Plumbing Blueprint Reading

D.001

Discuss the various ways in which drawings can be reproduced, including blue lines, black lines, sepias, and CAD.

D.002

Identify orthographic, oblique and isometric drawings.

D.003

Discuss how orthographic views are used to depict information about objects.

D.004

Explain how scale and dimensions are used to convey information on orthographic drawings.

D.005

Identify the basic symbols used in schematic drawings of pipe assemblies.

D.006

Discuss the characteristics of isometric drawings.

D.007

Discuss procedures used to make piping isometrics.

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E.

### Reading Residential Plumbing Drawings

E.001

List the types of drawings that may be included in a set of residential plans.

E.002

Distinguish between plans and specifications.

E. 003

Interpret plumbing related information from a set of residential plans.

E. 004

Understand the relationships that exist among the various drawings.

E. 005

Apply the local code requirements to given drawings.

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F.

### Joining Plastic Pipe and Fittings

F. 001

State the precautions that must be taken when installing refrigerant piping.

F. 002

Select the right tubing for a job.

F. 003

Cut and bend tubing.

- F. 004 Join tubing by using flare and compression fittings.
- F. 005 Determine the kinds of hangers and support needed for refrigerant piping.
- F. 006 Insulate refrigerant piping.
- F. 007 State the basic requirements for pressure-testing a system once it has been installed.
- F. 008 Follow basic safety precautions for the installation, operation and maintenance of refrigerating and air conditioning equipment.

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G.

### **Soldering and Brazing Copper Tubing and Fittings**

- G. 001 Assemble and operate the tools used for soldering.
- G. 002 Prepare tubing and fittings for soldering.
- G. 003 Identify the purposes and use of solder and solder fluxes.
- G. 004 Solder copper tubing and fittings.
- G. 005 Assemble and operate the tools used for brazing.
- G. 006 Prepare tubing and fittings for brazing.
- G. 007 Identify the purposes and use of filler metals and fluxes used for brazing.
- G. 008 Braze copper tubing and fittings.
- G. 009 Identify the inert gases that can safely be used to purge tubing when brazing.

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H.

### **Cutting and Threading Carbon Steel Pipe**

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I.

### **Joining Cast-Iron Pipe and Fittings**

- I. 001 Differentiate between cast iron hub-and spigot pipe and No-Hub pipe and fittings.
- I. 002 Identify the labeling system used for cast iron pipe and fittings.
- I. 003 State the sizes, weights, and availability of cast iron pipe and fittings.
- I. 004 Identify common fittings used with cast iron pipe.

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J.

### **Making Flared and Compression Joints with Copper Tube**

- J. 001 Identify fittings and soft copper tubing.
- J. 002 Discuss the advantages of flared and compression joints.

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K.

### **Installing Traps and Interceptors**

- K. 001 Describe the different types of traps and how they work.
- K. 002 Explain the local code requirements for trap installation.
- K. 003 Identify the critical dimensions in trap installation.

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L.

### **Fitting and Cleanout Requirements for DWV Piping**

- L. 001 Recognize the different types of DWV fittings.



- L. 002 Understand the application of the various kinds of DWV fittings used within the plumbing design.
- L. 003 Understand the application of the various kinds of DWV fittings in reference to code requirements.
- L. 004 Understand the use of cleanouts in the DWV piping system.
- L. 005 Become familiar with the code requirements for the size, direction and location of cleanouts.
- L. 006 Understand the placement of cleanouts on stacks, junctions and traps.
- L. 007 Understand the requirements for cleanout accessibility and clearance.
- L. 008 Understand the code requirements for manholes.

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- M. Installing Natural Gas Piping**
- M. 001 Understand how the code affects natural gas piping systems.
  - M. 002 Recognize the different types of natural gas distribution materials.
  - M. 003 Interpret plumbing drawings or blueprints to determine natural gas piping layouts.
  - M. 004 Recognize the parts of a gas system.
  - M. 005 Know testing and purging procedures.
  - M. 006 Understand appliance installation.

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- N. Installing LPG Piping Systems**
- N. 001 Understand how the code affects LPG piping systems.
  - N. 002 Recognize the different materials used in LPG piping systems.
  - N. 003 Recognize different types of storage containers.
  - N. 004 Interpret plumbing plans to determine layouts.
  - N. 005 Recognize the parts of a LPG system.
  - N. 006 Understand testing procedures for LPG systems.
  - N. 007 Install LPG appliances.

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- O. Installing Fuel Oil Piping Systems**
- O. 001 Understand how code affects fuel oil piping systems.
  - O. 002 Recognize the different types of fuel oil distribution materials.
  - O. 003 Interpret plumbing drawings or blueprints to determine fuel oil system layouts.
  - O. 004 Recognize the parts of a fuel oil system.
  - O. 005 Understand testing and bleeding procedures.
  - O. 006 Understand appliance installation.

## V. ELECTRICAL

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- A. Electrical Safety**
- A. 001 Demonstrate safe working procedures in a construction

environment.

- A. 002 Explain the purpose of OSHA and how it promotes safety on the job.
- A. 003 Identify electrical hazards and how to avoid or minimize them in the workplace.
- A. 004 Explain safety issues concerning lockout/tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection systems.

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**B.**

### **Hand Bending**

- B. 001 Identify the methods of hand bending conduit.
- B. 002 Identify the various methods used to install conduit.
- B. 003 Use math formulas to determine conduit bends.
- B. 004 Make 90° bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
- B. 005 Cut, ream, and thread conduit.

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**C.**

### **Anchors and Supports**

- C. 001 Identify and explain the use of threaded fasteners.
- C. 002 Identify and explain the use of non-threaded fasteners.
- C. 003 Identify and explain the use of anchors.
- C. 004 Demonstrate the correct applications for fasteners and anchors.
- C. 005 Install fasteners and anchors.

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**D.**

### **Electrical Theory One**

- D. 001 Recognize what atoms are and how they are constructed.
- D. 002 Define voltage and identify the ways in which it can be produced.
- D. 003 Explain the difference between conductors and insulators.
- D. 004 Define the units of measurement that are used to measure the properties of electricity.
- D. 005 Explain how voltage, current, and resistance are related to each other.
- D. 006 Using the formula for Ohm's Law, calculate an unknown value.
- D. 007 Explain the different types of meters used to measure voltage, current, and resistance.
- D. 008 Using the power formula, calculate the amount of power used by a circuit.
- D. 009 Explain how the relationship of work and power is applied to electrical circuits.
- D. 010 Calculate, using the power formula, the amount of power used by a circuit.

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**E.**

### **Electrical Theory Two**

- E. 001 Explain the basic characteristics of a series circuit.
- E. 002 Explain the basic characteristics of a parallel circuit.
- E. 003 Explain the basic characteristics of a series-parallel circuit.

- E. 004 Calculate, using Kirchoff's Voltage Law, the voltage drop in series, parallel, and series-parallel circuits.
- E. 005 Calculate, using Kirchoff's Current Law, the total current in parallel and series-parallel circuits.
- E. 006 Find the total amount of resistance in a series circuit.
- E. 007 Find the total amount of resistance in a parallel circuit.
- E. 008 Find the total amount of resistance in a series-parallel circuit.

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F.

### Electrical Test Equipment

F. 001

Explain the operation of and describe the following pieces of test equipment:

- Ammeter
- Ohmmeter
- Wattmeter
- Frequency meter
- Continuity tester
- Recording instruments
- Voltmeter
- Volt-ohm-milliammeter (VOM)
- Megohmmeter
- Power factor meter
- Voltage tester
- Cable-length meters

F. 002

Explain how to read and convert from one scale to another using the above test equipment.

F. 003

Explain the importance of proper meter polarity.

F. 004

Define frequency and explain the use of a frequency meter.

F. 005

Explain the difference between digital and analog meters.

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G.

### Introduction to the National Electrical Code

G. 001

Explain the purpose and history of the National Electrical Code (NEC).

G. 002

Describe the layout of the NEC.

G. 003

Explain how to navigate the NEC.

G. 004

Describe the purpose of the National Electrical Manufacturers' Association (NEMA) and the National Fire Protection Association (NFPA).

G. 005

Explain the role of testing laboratories.

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H.

### Raceways, Boxes, and Fittings

H. 001

Describe various types of cable trays and raceways.

H. 002

Identify and select various types and sizes of raceways.

H. 003

Identify and select various types and sizes of cable trays.

H. 004

Identify and select various types of raceway fittings.

H. 005

Identify various methods used to install raceways.

H. 006

Demonstrate knowledge of NEC raceway requirements.

H. 007

Describe procedures for installing raceways and boxes on masonry surfaces.

H. 008

Describe procedures for installing raceways and boxes on concrete surfaces.

H. 009

Describe procedures for installing raceways and boxes in a metal stud environment.

H. 010

Describe procedures for installing raceways and boxes in a wood frame environment.

- H. 011 Describe procedures for installing raceways and boxes on drywall surfaces.
- H. 012 Recognize safety precautions that must be followed when working with boxes and raceways.

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I.

### Conductors

- I. 001 Explain the various sizes and gauges of wire in accordance with American Wire Gauge Standards.
- I.002 Identify insulation and jacket types according to conditions and applications.
- I. 003 Describe voltage ratings of conductors and cables.
- I. 004 Read and identify markings on conductors and cables.
- I. 005 Use the tables in the NEC to determine the ampacity of a conductor.
- I. 006 State the purpose of stranded wire.
- I. 007 State the purpose of compressed conductors.
- I. 008 Describe the different materials from which conductors are made.
- I. 009 Describe the different types of conductor insulation.
- I. 010 Describe the color coding of insulation.
- I. 011 Describe instrumentation control wiring.
- I. 012 Describe the equipment required for pulling wire through conduit.
- I. 013 Describe the procedure for pulling wire through conduit.
- I. 014 Install conductors in conduit.
- I. 015 Pull conductors in a conduit system.

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J.

### Introduction to Electrical Blueprints

- J. 001 Explain the basic layout of a blueprint.
- J. 002 Describe the information included in the title block of a blueprint.
- J. 003 Identify the types of lines used on blueprints.
- J. 004 Identify common symbols used on blueprints.
- J. 005 Understand the use of architect's and engineer's scales.
- J. 006 Interpret electrical drawings, including site plans, floor plans, and detail drawings.
- J. 007 Read equipment schedules found on electrical blueprints.
- J. 008 Describe the type of information included in electrical specifications.

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K.

### Electrical Wiring: Commercial & Industrial

- K. 001 Identify and state the functions and ratings of single-pole, double-pole, three-way, four-way, dimmer, special, and safety switches.
- K. 002 Explain NEMA classifications as they relate to switches and enclosures.
- K. 003 Explain the NEC requirements concerning wiring devices.
- K. 004 Identify and state the functions and ratings of straight blade, twist lock, and pin and sleeve receptacles.
- K. 005 Identify and define receptacle terminals and disconnects.
- K. 006 Identify and define ground fault circuit interrupters.

K. 007	Explain the box mounting requirements in the NEC.
K. 008	Use a wire stripper to strip insulation from a wire.
K. 009	Use a solderless connector to splice wires together.
K. 010	Identify and state the functions of limit switches and relays.
K. 011	Identify and state the function of switchgear.

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### Electrical Wiring: Residential

L. 001	Describe how to determine electric service requirements for dwellings.
L. 002	Explain the grounding requirements of a residential electric service.
L. 003	Calculate and select service-entrance equipment.
L. 004	Select the proper wiring methods for various types of residences.
L. 005	Explain the role of the NEC in residential wiring.
L. 006	Compute branch circuit loads and explain their installation requirements.
L. 007	Explain the types and purposes of equipment grounding conductors.
L. 008	Explain the purpose of ground fault circuit interrupters and tell where they must be installed.
L. 009	Size outlet boxes and select the proper type for different wiring methods.
L. 010	Describe rules for installing electric space heating and HVAC equipment.
L. 011	Describe the installation rules for electrical systems around swimming pools, spas, and hot tubs.
L. 012	Explain how wiring devices are selected and installed.
L. 013	Describe the installation and control of lighting fixtures.

## VI. HVAC

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### Trade Mathematics

A. 001	Solve algebraic equations that relate to the HVAC trade.
A. 002	Calculate volume, weight, pressure, vacuum, and temperature.
A. 003	Construct simple geometric figures and solve basic geometry problems that relate to the HVAC trade.

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### Tools of the Trade

B. 001	Identify and demonstrate the ability to use the following tools: <ul style="list-style-type: none"> <li>• Pipe wrenches</li> <li>• Torque wrenches</li> <li>• Tinner's and soft face hammers</li> <li>• Hand cutting snips</li> <li>• Hand and power hacksaws</li> <li>• Drill press</li> <li>• Measuring Tools</li> </ul>
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**C. Copper and Plastic Piping Practices**

- C. 001 State the precautions that must be taken when installing refrigerant piping.
- C. 002 Select the right tubing for a job.
- C. 003 Cut and bend tubing.
- C. 004 Join tubing by using flare and compression fittings.
- C. 005 Determine the kinds of hangers and support needed for refrigerant piping.
- C. 006 Insulate refrigerant piping.
- C. 007 State the basic requirements for pressure-testing a system once it has been installed.
- C. 008 Follow basic safety precautions for the installation, operating and maintenance of refrigerating and air conditioning equipment.

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**D. Soldering and Brazing**

- D. 001 Assemble and operate the tools used for soldering.
- D. 002 Prepare tubing and fittings for soldering.
- D. 003 Identify the purposes and use of solder and solder fluxes.
- D. 004 Solder copper tubing and fittings.
- D. 005 Assemble and operate the tools used for brazing.
- D. 006 Prepare tubing and fittings for brazing.
- D. 007 Identify the purposes and use of filler metals and fluxes used for brazing.
- D. 008 Braze copper tubing and fittings.
- D. 009 Identify the inert gases that can safely be used to purge tubing when brazing.

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**E. Ferrous Metal Piping Practices**

- E. 001 Identify the types of ferrous metal pipes.
- E. 002 Measure the sizes of ferrous metal pipes.
- E. 003 Identify the common malleable iron fittings.
- E. 004 Cut, ream and thread ferrous metal pipe.
- E. 005 Join lengths of threaded pipe together and install fittings.
- E. 006 Describe the main points to consider when installing pipe runs.
- E. 007 Describe the method used to join grooved piping.

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**F. Basic Electricity**

- F. 001 State how electrical power is generated and distributed.
- F. 002 Describe how voltage, current, resistance, and power are related.
- F. 003 Use Ohm's Law to calculate the current, voltage, and resistance in a circuit.
- F. 004 Use the power formula to calculate how much power is consumed by a circuit.

- F. 005 Describe the differences between series and parallel circuits.
- F. 006 Recognize and describe the purpose and operation of the various electrical components used in HVAC equipment.
- F. 007 State and demonstrate the safety precaution that must be followed when working on electrical equipment.
- F. 008 Make voltage, current, and resistance measurements using electrical test equipment.

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- G. Introduction to Cooling**
- G. 001 Explain how heat transfer occurs in a cooling system, demonstrating an understanding of the terms and concepts used in the refrigeration cycle.
  - G. 002 Calculate the temperature and pressure relationships at key points in the refrigeration cycle.
  - G. 003 Under supervision, use temperature and pressure measuring instruments to make readings at key points in the refrigeration cycle.
  - G. 004 Identify commonly used refrigerants and demonstrate the procedures for handling these refrigerants.
  - G. 005 Recognize the major components of a cooling system and explain how each type works.
  - G. 006 Recognize the major accessories available with cooling systems and explain how each type works.
  - G. 007 Recognize the control devices used in cooling systems and explain how each type works.
  - G. 008 Under supervision, perform basic power-off maintenance procedures applicable to cooling systems.
  - G. 009 State the correct methods to be used when piping a refrigeration or cooling system.

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- H. Introduction to Heating**
- H. 001 Explain the three methods by which heat is transferred and give an example of each.
  - H. 002 Describe how combustion occurs and identify the by products of combustion.
  - H. 003 Identify the various types of fuels used in heating.
  - H. 004 Recognize the major components and accessories of a forced-air furnace and explain the function of each component.
  - H. 005 State the factors that must be considered when installing a furnace.
  - H. 006 Identify the major components of a gas furnace and describe how each works.
  - H. 007 With supervision, use a manometer to measure and adjust manifold pressure on a gas furnace.
  - H. 008 Identify the major components of an oil furnace and describe how each works.
  - H. 009 Describe how an electric furnace works.
  - H. 010 With supervision, perform basic furnace preventive

maintenance procedures such as cleaning and filter replacement.

## VII. INDUSTRIAL MAINTENANCE – LEVEL I

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### A. Electrical Safety

- A.001 Demonstrate safe working procedures in a construction environment.
- A.002 Explain the purpose of OSHA and how it promotes safety on the job.
- A.003 Identify electrical hazards and how to avoid or minimize them in the workplace.
- A.004 Explain safety issues concerning lockout/tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection systems.

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### B. Hand Bending

- B.001 Identify the methods of hand bending conduit.
- B.002 Identify the various methods used to install conduit.
- B.003 Use math formulas to determine conduit bends.
- B.004 Make 90° bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
- B.005 Cut, ream, and thread conduit.

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### C. Fasteners and Anchors

- C.001 Identify and explain the use of threaded fasteners.
- C.002 Identify and explain the use of non-threaded fasteners.
- C.003 Identify and explain the use of anchors.
- C.004 Demonstrate the correct applications for fasteners and anchors.
- C.005 Install fasteners and anchors.

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### D. Electrical Theory One

- D.001 Recognize what atoms are and how they are constructed.
- D.002 Define voltage and identify the ways in which it can be produced.
- D.003 Explain the difference between conductors and insulators.
- D.004 Define the units of measurement that are used to measure the properties of electricity.
- D.005 Explain how voltage, current, and resistance are related to each other.
- D.006 Using the formula for Ohm's Law, calculate an unknown value.
- D.007 Explain the different types of meters used to measure voltage, current, and resistance.
- D.008 Using the power formula, calculate the amount of power used by a circuit.



- D.009 Explain how the relationship of work and power is applied to electrical circuits.
- D.010 Calculate, using the power formula, the amount of power used by a circuit.

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**E. Electrical Theory Two**

- E.001 Explain the basic characteristics of a series circuit.
- E.002 Explain the basic characteristics of a parallel circuit.
- E.003 Explain the basic characteristics of a series-parallel circuit.
- E.004 Calculate, using Kirchoff's Voltage Law, the voltage drop in series, parallel, and series-parallel circuits.
- E.005 Calculate, using Kirchoff's Current Law, the total current in parallel and series-parallel circuits.
- E.006 Find the total amount of resistance in a series circuit.
- E.007 Find the total amount of resistance in a parallel circuit.
- E.008 Find the total amount of resistance in a series-parallel circuit.

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**F. Electrical Test Equipment**

- F.001 Explain the operation of and describe the following pieces of test equipment:
- Ammeter
  - Ohmmeter
  - Wattmeter
  - Frequency meter
  - Continuity tester
  - Recording instruments
  - Voltmeter
  - Volt-ohm-milliammeter (VOM)
  - Megohmmeter
  - Power factor meter
  - Voltage tester
  - Cable-length meters
- F.002 Explain how to read and convert from one scale to another using the above test equipment.
- F.003 Explain the importance of proper meter polarity.
- F.004 Define frequency and explain the use of a frequency meter.
- F.005 Explain the difference between digital and analog meters.

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**G. Introduction to the National Electrical Code**

- G.001 Explain the purpose and history of the National Electrical Code (NEC).
- G.002 Describe the layout of the NEC.
- G.003 Explain how to navigate the NEC.
- G.004 Describe the purpose of the National Electrical Manufacturers' Association (NEMA) and the National Fire Protection Association (NFPA).
- G.005 Explain the role of testing laboratories.

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**H. Conductors**

- H.001 Explain the various sizes and gauges of wire in accordance with American Wire Gauge standards.
- H.002 Identify insulation and jacket types according to conditions and applications.

H.003	Describe voltage ratings of conductors and cables.
H.004	Read and identify markings on conductors and cables.
H.005	Use the tables in the NEC to determine the ampacity of a conductor.
H.006	State the purpose of stranded wire.
H.007	State the purpose of compressed conductors.
H.008	Describe the different materials from which conductors are made.
H.009	Describe the different types of conductor insulation.
H.010	Describe the color coding of insulation.
H.011	Describe instrumentation control wiring.
H.012	Describe the equipment required for pulling wire through conduit.
H.013	Describe the procedure for pulling wire through conduit.
H.014	Install conductors in conduit.
H.015	Pull conductors in a conduit system.

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**I.**

**Introduction to Electrical Blueprints**

I.001	Explain the basic layout of a blueprint
I.002	Describe the information included in the title block of a blueprint.
I.003	Identify the types of lines used on blueprints.
I.004	Identify common symbols used on blueprints.
I.005	Understand the use of architect's and engineer's scales.
I.006	Interpret electrical drawings, including site plans, floor plans, and detail drawings.
I.007	Read equipment schedules found on electrical blueprints.
I.008	Describe the type of information included in electrical specifications.

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**J.**

**Oxyfuel Cutting**

J.001	Explain oxyfuel cutting safety.
J.002	Identify and explain oxyfuel cutting equipment.
J.003	Set up oxyfuel equipment.
J.004	Light and adjust an oxyfuel torch.
J.005	Shut down oxyfuel cutting equipment.
J.006	Disassemble oxyfuel equipment.
J.007	Change empty cylinders.
J.008	Perform oxyfuel cutting: <ul style="list-style-type: none"> <li>• Straight line and square shapes</li> <li>• Piercing and slot cutting</li> <li>• Bevels</li> <li>• Washing</li> <li>• Gouging</li> </ul>

**VIII. INDUSTRIAL MAINTENANCE – LEVEL II**

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**A.**

**Wiring: Commercial & Industrial**

A.001	Identify and state the functions and ratings of single-pole, double-pole, three-way, four-way, dimmer, special, and safety switches.
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- A.002 Explain NEMA classifications as they relate to switches and enclosures.
- A.003 Explain the NEC requirements concerning wiring devices.
- A.004 Identify and state the functions and ratings of straight blade, twist lock, and pin and sleeve receptacles.
- A.005 Identify and define receptacle terminals and disconnects.
- A.006 Identify and define ground fault circuit interrupters.
- A.007 Explain the box mounting requirements in the NEC.
- A.008 Use a wire stripper to strip insulation from a wire.
- A.009 Use a solderless connector to splice wires together.
- A.010 Identify and state the functions of limit switches and relays.
- A.011 Identify and state the function of switchgear.

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**B. Alternating Current**

- B.001 Calculate the peak and effective voltage or current values for an AC waveform.
- B.002 Calculate the phase relationship between two AC waveforms.
- B.003 Describe the voltage and current phase relationship in a resistive AC circuit.
- B.004 Describe the voltage and current transients that occur in an inductive circuit.
- B.005 Define inductive reactance and state how it is affected by frequency.
- B.006 Describe the voltage and current transients that occur in a capacitive circuit.
- B.007 Define capacitive reactance and state how it is affected by frequency.
- B.008 Explain the relationship between voltage and current in the following types of AC circuits:
  - RL circuit
  - RC circuit
  - LC circuit
  - RLC circuit
- B.009 Describe the effect that resonant frequency has on impedance and current flow in a series or parallel resonant circuit.
- B.010 Define bandwidth and describe how it is affected by resistance in a series or parallel resonant circuit.
- B.011 Explain the following terms as they relate to AC circuits:
  - True power
  - Apparent power
  - Reactive power
  - Power factor
- B.012 Explain basic transformer action.

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**C. Motors: Theory and Application**

- C.001 Define the following terms:
  - Ampacity
  - NEMA design letter
  - Branch circuit
  - Nonautomatic
  - Circuit breaker
  - Overcurrent
  - Controller
  - Overload
  - Duty
  - Power factor

- Equipment
  - Full-load amps
  - Ground fault circuit interrupter
  - Interrupting switch
  - Motor circuit switch
  - Thermal protector
  - Rated full-load speed
  - Rated horsepower
  - Service factor
  - Thermal cutout
  - Remote control circuit
- C.002 Describe the various types of motor enclosures.
- C.003 Describe how the rated voltage of a motor differs from the system voltage.
- C.004 Describe the basic construction and components of a three-phase squirrel cage induction motor.
- C.005 Explain the relationships among speed, frequency, and the number of poles in a three-phase induction motor.
- C.006 Describe how torque is developed in an induction motor.
- C.007 Explain how and why torque varies with rotor reactance and slip.
- C.008 Define percent slip and speed regulation.
- C.009 Explain how the direction of a three-phase motor is reversed.
- C.010 Describe the component parts and operating characteristics of a three-phase wound rotor induction motor.
- C.011 Describe the component parts and operating characteristics of a three-phase synchronous motor.
- C.012 Define torque, starting current, and armature reaction as they apply to DC motors.
- C.013 Explain how the direction of rotation of a DC motor is changed.
- C.014 Describe the design and characteristics of a DC shunt, series, and compound motor.
- C.015 Describe dual-voltage motors and their applications.
- C.016 Describe the methods for determining various motor connections.
- C.017 Describe general motor protection requirements as delineated in the NEC.

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- D. Grounding**
- D.001 Explain the purpose of grounding and the scope of NEC Article 250.
- D.002 Distinguish between a short circuit and a ground fault.
- D.003 Define the NEC ground-related terms.
- D.004 Distinguish between system grounding and equipment grounding.
- D.005 Use NEC Table 250-66 to size the grounding electrode conductor for various AC systems.
- D.006 Explain the NEC requirements for the installation and physical protection of grounding electrode conductors.
- D.007 Explain the function of the grounding electrode system and determine which grounding electrodes must be used.
- D.008 Define made electrodes and explain the resistance requirements for made electrodes using NEC Section 250-52.
- D.009 Use NEC Table 250-122 to size the equipment grounding conductor for raceways and equipment.
- D.010 Explain the function of the main bonding jumper in the grounding system and size the main bonding jumper for various applications.

- D.011 Size the main bonding jumper for a service utilizing multiple service disconnecting means.
- D.012 Explain the NEC requirements for bonding of enclosures and equipment.
- D.013 Explain the NEC requirements for grounding of enclosures and equipment.
- D.014 Explain effectively grounded and its importance in clearing ground faults and short circuits.
- D.015 Explain the purposes of the grounded conductor (neutral) in the operation of overcurrent devices.
- D.016 Explain the NEC requirements for grounding separately derived systems, including transformers and generators.
- D.017 Explain the NEC requirements for grounding at more than one building.
- D.018 Explain the NEC grounding requirements for systems over 600 volts.

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- E. Boxes and Fittings**
- E.001 Describe the different types of nonmetallic and metallic boxes.
- E.002 Understand the NEC requirements for box fill.
- E.003 Calculate the required box size for any number and size of conductors.
- E.004 Explain the NEC regulations for volume required per conductor in outlet boxes.
- E.005 Properly locate, install, and support boxes of all types.
- E.006 Describe the NEC regulations governing pull and junction boxes.
- E.007 Explain the radius rule when installing conductors in pull boxes.
- E.008 Understand the NEC requirements for boxes supporting lighting fixtures.
- E.009 Describe the purpose of conduit bodies and Type FS boxes.
- E.010 Install the different types of fittings used in conjunction boxes.
- E.011 Describe the installation rules for installing boxes and fittings in hazardous areas.
- E.012 Explain how boxes and fittings are selected and installed.
- E.013 Describe the various types of box supports.

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- F. Cable Tray**
- F.001 Describe the components that make up a cable tray assembly.
- F.002 Explain the methods used to hang and secure cable tray.
- F.003 Describe how cable enters and exits cable tray.
- F.004 Select the proper cable tray fitting for the situation.
- F.005 Explain the NEMA standards for cable tray installations.
- F.006 Explain the NEC requirements for cable tray installations.
- F.007 Select the required fittings to ensure equipment grounding continuity in cable tray systems.
- F.008 Interpret electrical working drawings showing cable tray fittings.
- F.009 Size cable tray for the number and type of conductors contained in the system.

- F.010 Select rollers and sheaves for pulling cable in specific cable tray situations.
- F.011 Designate the required locations of rollers and sheaves for a specific cable pull.
- F.012 Fabricate an offset for a cable tray.

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**G. Conductor Terminations**

- G.001 Describe how to make a good conductor termination.
- G.002 Prepare cable ends for terminations and splices.
- G.003 Install lugs and connectors onto conductors.
- G.004 Train cable at termination points.
- G.005 Explain the role of the NEC in making cable terminations and splices.
- G.006 Explain why mechanical stress should be avoided at cable termination points.
- G.007 Describe the importance of using proper bolt torque when bolting lugs onto busbars.
- G.008 Describe crimping techniques.
- G.009 Select the proper lug or connector for the job.
- G.010 Describe splicing techniques.
- G.011 Describe the installation rules for parallel conductors.
- G.012 Explain how to use hand and power crimping tools.

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**H. Installation of Electric Services**

- H.001 Describe various types of electric services for commercial and industrial installations.
- H.002 Read electrical blueprints and diagrams describing service installations.
- H.003 Calculate and select service-entrance equipment.
- H.004 Explain the role of the NEC in service installations.
- H.005 Install main disconnect switches, panelboards, and overcurrent protection devices.
- H.006 Identify the circuit loads, number of circuits required, and installation requirements for distribution panels.
- H.007 Explain the types and purposes of service grounding.
- H.008 Explain the purpose of ground fault circuit interrupters and where they must be installed.
- H.009 Describe single-phase service connections.
- H.010 Describe both wye- and delta-connected three-phase services.

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**I. Circuit Breakers and Fuses**

- I.001 Explain the necessity of overcurrent protection devices in electrical circuits.
- I.002 Define the terms associated with fuses and circuit breakers.
- I.003 Describe the operation of a circuit breaker.
- I.004 Select the most suitable overcurrent device for the application.
- I.005 Explain the role of the NEC in specifying overcurrent devices.

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|-------|--------|--|
| I.006 | lives. | Describe the operation of single-element and time-delay fuses.               |
| I.007 |        | Explain how ground fault circuit interrupters (GFCIs) can save               |
| I.008 |        | Replace a renewable fuse link.   |
| I.009 |        | Calculate short circuit currents.  |
| I.010 |        | Describe troubleshooting and maintenance techniques for overcurrent devices. |

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**J.**

**Contactors and Relays**

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| J.001 | Describe the operating principles of contactors and relays.          |
| J.002 | Select contactors and relays for use in specific electrical systems. |
| J.003 | Explain how mechanical contactors operate.                           |
| J.004 | Explain how solid-state contactors operate.                          |
| J.005 | Install contactors and relays according to the NEC requirements.     |
| J.006 | Select and install contactors and relays for lighting control.       |
| J.007 | Read wiring diagrams involving contactors and relays.                |
| J.008 | Describe how overload relays operate.                                |
| J.009 | Connect a simple control circuit.                                    |
| J.010 | Test control circuits.   |

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**K.**

**Lubrication**

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|-------|---|
| K.001 | Explain OSHA standards.                                     |
| K.002 | Read and interpret an MSDS.                                 |
| K.003 | Explain the EPA program.                                    |
| K.004 | Explain lubricant storage.                                  |
| K.005 | Explain lubricant classification.                           |
| K.006 | Explain lubricant film protection.                          |
| K.007 | Explain properties of lubricants.                           |
| K.008 | Explain properties of greases.                              |
| K.009 | Explain how to select lubricants.                           |
| K.010 | Identify and explain types of additives.                    |
| K.011 | Identify and explain types of lubricating oils.             |
| K.012 | Identify and use lubrication equipment to apply lubricants. |
| K.013 | Read and interpret a lubrication chart.                     |

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**L.**

**Introduction to Bearings**

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|-------|---|
| L.001 | Identify and explain plain bearings.        |
| L.002 | Identify and explain ball bearings.         |
| L.003 | Identify and explain roller bearings.       |
| L.004 | Identify and explain thrust bearings.       |
| L.005 | Identify and explain guide bearings.        |
| L.006 | Identify and explain flanged bearings.      |
| L.007 | Identify and explain pillow block bearings. |
| L.008 | Identify and explain takeup bearings.       |
| L.009 | Identify and explain bearing materials.     |

L.010 Explain bearing designation.

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**M.**

**Copper and Plastic Piping Practices**

M.001

State the precautions that must be taken when installing refrigerant piping.

M.002

Select the right tubing for a job.

M.003

Cut and bend tubing.

M.004

Join tubing by using flare and compression fittings.

M.005

Determine the kinds of hangers and support needed for refrigerant piping.

M.006

Insulate refrigerant piping.

M.007

State the basic requirements for pressure-testing a system once it has been installed.

M.008

Follow basic safety precautions for the installation, operation and maintenance of refrigerating and air conditioning equipment.

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**N.**

**Ferrous Metal Piping Practices**

N.001

Identify the types of ferrous metal pipes.

N.002

Measure the sizes of ferrous metal pipes.

N.003

Identify the common malleable iron fittings.

N.004

Cut, ream and thread ferrous metal pipe.

N.005

Join lengths of threaded pipe together and install fittings.

N.006

Describe the main points to consider when installing pipe runs.

N.007

Describe the method used to join grooved piping.

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**O.**

**Piping Systems**

O.001

Identify and explain the types of piping systems.

O.002

Identify piping systems according to color-coding.

O.003

Explain thermal expansion.

O.004

Explain types and applications of pipe insulation.

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**P.**

**SMAW Equipment and Setup**

P.001

Identify and explain SMAW safety.

P.002

Identify and explain welding electrical current.

P.003

Identify and explain arc welding machines.

P.004

Explain setting up arc welding equipment.

P.005

Identify and explain tools for weld cleaning.



## Occupational Skills

The student demonstrates the specified level of competency in occupational skills.

<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>No exposure</b>	<b>Introduced</b>	<b>Practiced</b>	<b>Entry-Level</b>	<b>Competency</b>

### Core Instruction

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### Basic Construction Skills

- A. Orientation to the Trade
- B. Safety
- C. Math
- D. Hand Tools
- E. Power Tools
- F. Blueprints
- G. Wood Materials and Fastening

### Specialization Options (choose at least 2 sub areas)

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### Carpentry – Level I

- A. Rigging
- B. Tools
- C. Floor Systems
- D. Wall and Ceiling Framing
- E. Roof Framing
- F. Windows and Exterior Doors

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### Carpentry – Level II

- A. Reading Plans and Elevations
- B. Site Layout I: Distance Measurement and Leveling
- C. Introduction to Concrete and Reinforcing Materials
- D. Foundations and Flatwork
- E. Concrete Forms
- F. Reinforcing Concrete
- G. Handling and Placing Concrete
- H. Patented Forms
- I. Tilt-Up Wall Systems

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### Masonry

- A. Residential Plans and Drawing Interpretation
- B. Residential Masonry
- C. Grout and Other Reinforcement

- ☐ ☐ ☐ ☐ ☐ D. Metal Work in Masonry
- ☐ ☐ ☐ ☐ ☐ E. Advanced Laying Techniques
- ☐ ☐ ☐ ☐ ☐ F. Construction Techniques and Moisture Control
- ☐ ☐ ☐ ☐ ☐ G. Elevated Work
- ☐ ☐ ☐ ☐ ☐ H. Construction Inspection and Quality Control

### **Concrete Finishing**

- ☐ ☐ ☐ ☐ ☐ A. Introduction to Concrete Construction and Finishing
- ☐ ☐ ☐ ☐ ☐ B. Safety Requirements
- ☐ ☐ ☐ ☐ ☐ C. Properties of Concrete
- ☐ ☐ ☐ ☐ ☐ D. Tools and Equipment
- ☐ ☐ ☐ ☐ ☐ E. Preparing and Placement
- ☐ ☐ ☐ ☐ ☐ F. Placing Concrete
- ☐ ☐ ☐ ☐ ☐ G. Finishing: Part I
- ☐ ☐ ☐ ☐ ☐ H. Curing and Protecting Concrete
- ☐ ☐ ☐ ☐ ☐ I. Introduction to Troubleshooting

### **Plumbing**

- ☐ ☐ ☐ ☐ ☐ A. The Plumbing Trade
- ☐ ☐ ☐ ☐ ☐ B. Basic Plumbing Tools
- ☐ ☐ ☐ ☐ ☐ C. Math for Plumbers
- ☐ ☐ ☐ ☐ ☐ D. Introduction to Plumbing Blueprint Reading
- ☐ ☐ ☐ ☐ ☐ E. Reading residential Plumbing Drawings
- ☐ ☐ ☐ ☐ ☐ F. Joining Plastic Pipe and Fittings
- ☐ ☐ ☐ ☐ ☐ G. Soldering and Brazing Copper Tubing and Fittings
- ☐ ☐ ☐ ☐ ☐ H. Cutting and Threading Carbon Steel Pipe
- ☐ ☐ ☐ ☐ ☐ I. Joining Cast-Iron Pipe and Fittings
- ☐ ☐ ☐ ☐ ☐ J. Making Flared and Compression Joints with Copper Tube
- ☐ ☐ ☐ ☐ ☐ K. Installing Traps and Interceptors
- ☐ ☐ ☐ ☐ ☐ L. Fitting and Cleanout Requirements for DWV Piping
- ☐ ☐ ☐ ☐ ☐ M. Installing Natural Gas Piping
- ☐ ☐ ☐ ☐ ☐ N. Installing LPG Piping Systems
- ☐ ☐ ☐ ☐ ☐ O. Installing Fuel Oil Piping Systems

### **Electrical**

- ☐ ☐ ☐ ☐ ☐ A. Electrical Safety
- ☐ ☐ ☐ ☐ ☐ B. Hand Bending
- ☐ ☐ ☐ ☐ ☐ C. Anchors and Supports
- ☐ ☐ ☐ ☐ ☐ D. Electrical Theory One
- ☐ ☐ ☐ ☐ ☐ E. Electrical Theory Two
- ☐ ☐ ☐ ☐ ☐ F. Electrical Test Equipment
- ☐ ☐ ☐ ☐ ☐ G. Introduction to the National Electrical Code
- ☐ ☐ ☐ ☐ ☐ H. Raceways, Boxes, and Fittings
- ☐ ☐ ☐ ☐ ☐ I. Conductors
- ☐ ☐ ☐ ☐ ☐ J. Introduction to Electrical Blueprints

- K. Electrical Wiring: Commercial and Industrial
- L. Electrical Wiring: Residential

### **HAVC**

- A. Trade Mathematics
- B. Tools of the Trade
- C. Copper and Plastic Piping Practices
- D. Soldering and Brazing
- E. Ferrous Metal Piping Practices
- F. Basic Electricity
- G. Introduction to Cooling
- H. Introduction to Heating

### **Industrial Maintenance – Level I**

- A. Electrical Safety
- B. Hand Bending
- C. Fasteners and Anchors
- D. Electrical Theory One
- E. Electrical Theory Two
- F. Electrical Test Equipment
- G. Introduction to the National Electrical Code
- H. Conductors
- I. Introduction to Electrical Blueprints
- J. Oxyfuel Cutting

### **Industrial Maintenance – Level II**

- A. Wiring: Commercial & Industrial
- B. Alternating Current
- C. Motors: Theory and Application
- D. Grounding
- E. Boxes and Fittings
- F. Cable Tray
- G. Conductor Terminations
- H. Installation of Electric Services
- I. Circuit Breakers and Fuses
- J. Contactors and Relays
- K. Lubrication
- L. Introduction to Bearings
- M. Copper and Plastic Piping Practices
- N. Ferrous Metal Piping Practices
- O. Piping Systems
- P. SMAW Equipment and Setup